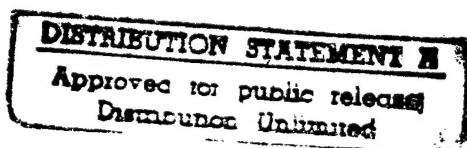


FINAL REPORT  
DECEMBER 1996

REPORT NO. 96-49

81MM MORTAR PLASTIC PALLET  
MIL-STD-1660 TESTS



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Prepared for:

U.S. Army Armament Research, Development  
and Engineering Center  
ATTN: AMSTA-AR-ESK  
Rock Island, IL 61299-7300

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VALIDATION ENGINEERING DIVISION  
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<p>The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SIOAC-DEV), was tasked by the U.S. Army Armament Research, Development and Engineering Center (ARDEC) to conduct MIL-STD-1660 tests on an 81mm mortar in plastic container on a plastic pallet. This report contains test results with the pallets provided passing MIL-STD-1660, Design Criteria for Ammunition Unit Loads, requirements. This pallet does not meet size requirements for field use; i.e., not double-wing design.</p>			
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81MM MORTAR PLASTIC PALLET MIL-STD-1660 TESTS

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## PART 1

### INTRODUCTION

- A. BACKGROUND. The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SIOAC-DEV), was tasked by the U.S. Army Armament Research, Development and Engineering Center (ARDEC) to conduct MIL-STD-1660 tests on an 81mm mortar plastic pallet.
- B. AUTHORITY. This test was conducted IAW mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Rock Island, Illinois.
- C. OBJECTIVE. The objective of these tests was to ascertain that the 81mm mortar in a plastic container on a plastic pallet would be safe for transportation (see part 6). Note that the plastic pallet was not a double configuration; therefore, it would not be suitable for use. This test was only to confirm that the unit load would remain intact through MIL-STD-1660 testing.
- D. CONCLUSION. The 81mm plastic pallet passed MIL-STD-1660 test criteria; however, the plastic pallet did not contain design features (double-wing) required for ammunition pallets.

## PART 2

DECEMBER 1996

### ATTENDEES

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## PART 3

### TEST PROCEDURES

The test procedures outlined in this section were extracted from MIL-STD-1660, Design Criteria for Ammunition Unit Loads, 8 April 1977. This standard identifies nine steps that a unitized load must undergo if it is to be considered acceptable. The four tests that were conducted on the test pallets are summarized below.

A. STACKING TEST. The unit load was loaded to simulate a stack of identical unit loads stacked 16 feet high, for a period of one hour. This stacking load was simulated by subjecting the unit load to a compression weight equal to an equivalent 16-foot stacking height. The compression load was calculated in the following manner. The unit load weight was divided by the unit load height in inches and multiplied by 192. The resulting number was the equivalent compressive force of a 16-foot-high load.

B. REPETITIVE SHOCK TEST. The repetitive shock test was conducted IAW Method 5019, Federal Standard 101. The test procedure is as follows: The test specimen was placed on, but not fastened to, the platform. With the specimen in one position, the platform was vibrated at 1/2-inch amplitude (1-inch double amplitude) starting at a frequency of approximately 3 cycles per second. The frequency was steadily increased until the package left the platform. The resonant frequency was achieved when a 1/16-inch-thick feeler gage momentarily slid freely between every point on the specimen in contact with the platform at some instance during the cycle or a platform acceleration achieved  $1 \pm 0.1$  Gs. Midway into the testing period, the specimen was rotated 90 degrees and the test continued for the duration. Unless failure occurred, the total time of vibration was two hours if the specimen was tested in one position and three hours for more than one position.

C. EDGEWISE ROTATIONAL DROP TEST. This test was conducted using the procedures of Method 5008, Federal Standard 101. The procedure for the edgewise rotational drop test is as follows: The specimen was placed on its skids with one end of the pallet supported on a beam 4-1/2 inches high. The height of the beam was increased if necessary to ensure that there was no support for the skids between the ends of the pallet when dropping took place, but was not high enough to cause the pallet to slide on the supports when the dropped end was raised for the drops. The unsupported end of the pallet was then raised and allowed to fall freely to the concrete, pavement, or similar underlying surface from a prescribed height. Unless otherwise specified, the height of drop for level A protection conforms to the following tabulation:

GROSS WEIGHT (WITHIN RANGE LIMITS) <u>(Pounds)</u>	DIMENSIONS OF ANY EDGE, HEIGHT OR WIDTH (WITHIN RANGE LIMITS) <u>(Inches)</u>	HEIGHT OF DROPS ON EDGES	
		Level A <u>(Inches)</u>	Level B <u>(Inches)</u>
150 - 250	60 - 66	36	27
250 - 400	66 - 72	32	24
400 - 600	72 - 80	28	21
600 - 1000	80 - 95	24	18
1000 - 1500	95 - 114	20	16
1500 - 2000	114 - 144	17	14
2000 - 3000	Above 145 - No limit	15	12
Above - 3000		12	9

D. INCLINE-IMPACT TEST. This test was conducted by using the procedure of Method 5023, Incline-Impact Test of Federal Standard 101. The procedure for the incline-impact test is as follows: The specimen was placed on the carriage with the surface or edge which is to be

impacted projecting at least 2 inches beyond the front end of the carriage. The carriage was brought to a predetermined position on the incline and released. If it is desired to concentrate the impact on any particular position on the container, a 4- by 4-inch timber was attached to the bumper in the desired position before the test. No part of the timber was struck by the carriage. The position of the container on the carriage and the sequence in which surfaces and edges are subjected to impacts was at the option of the testing activity and depends upon the objective of the tests. This test is to determine satisfactory requirements for a container or pack, and, unless otherwise specified, the specimen was subjected to one impact on each surface that has each dimension less than 9.5 feet. Unless otherwise specified, the velocity at time of impact was 7 feet per second.

## PART 4

### TEST EQUIPMENT

#### A. Pallet (Test Sample).

1. Height:	51 inches
2. Width:	45 inches
3. Length:	44.5 inches
4. Weight:	1,848 pounds

#### B. Compression Tester.

1. Manufacturer:	Ormond Manufacturing
2. Platform:	60- by 60-inches
3. Compression Limit:	50,000 pounds
4. Tension Limit:	50,000 pounds

#### C. Transportation Simulator.

1. Manufacturer:	Gaynes Laboratory
2. Capacity:	6,000-pound pallet
3. Displacement:	1/2-inch amplitude
4. Speed:	50 to 400 rpm
5. Platform:	5- by 8-foot

#### D. Inclined Plane.

1. Manufacturer:	Conbur Incline
2. Type:	Impact Tester
3. Grade:	10 percent incline
4. Length:	12-foot

## PART 5

### TEST RESULTS

A. STACKING TEST. The pallet weight was 1,848 pounds and the pallet height was 51 inches. Subject pallet was loaded to 7,200 pounds compression for a period of one hour. At the end of one hour, the compression decreased to approximately 5,500 pounds. When the test specimen was removed from the compression tester, no measurable deformation to the unit was noticed.

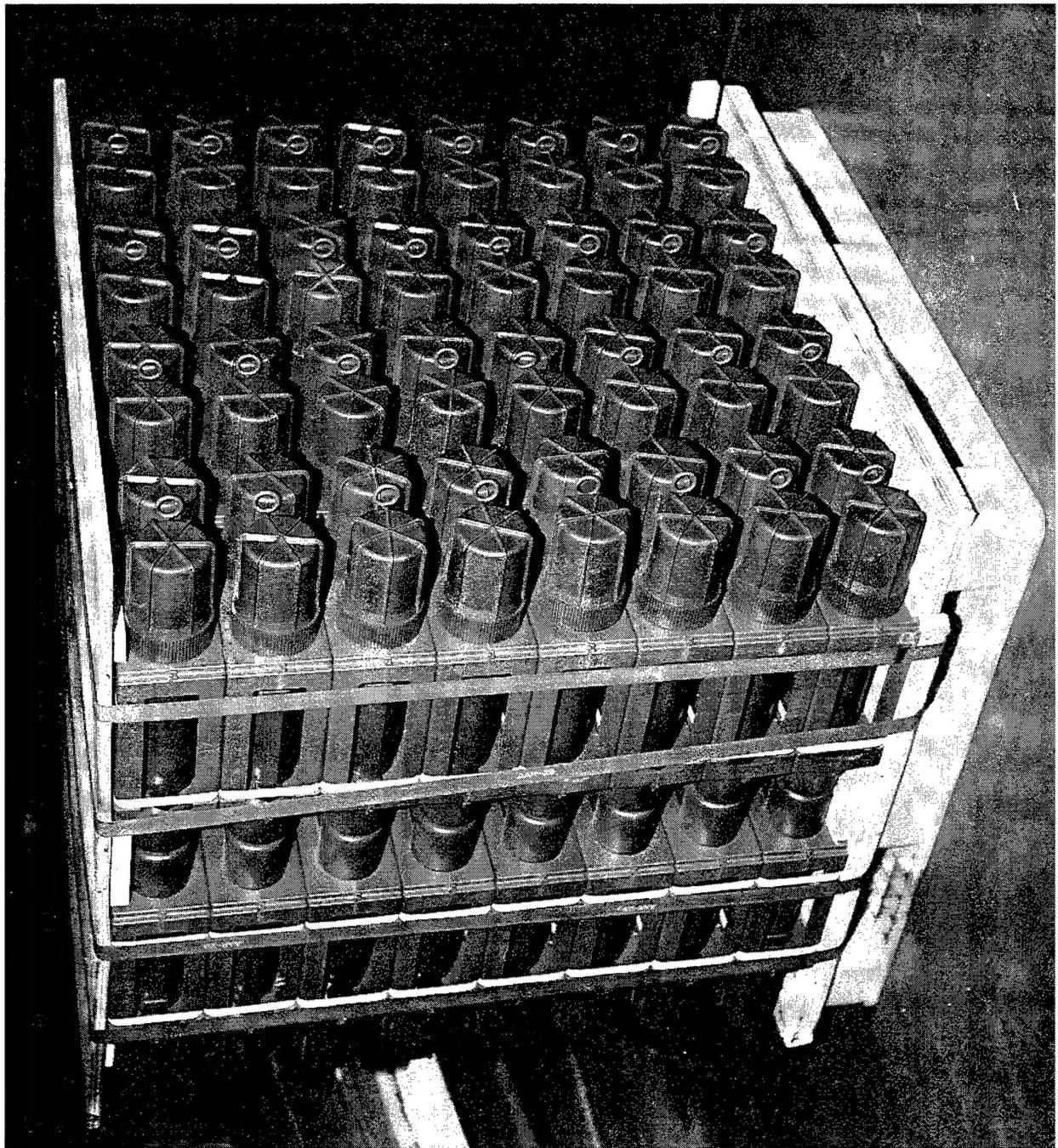
B. REPETITIVE SHOCK TEST. Subject pallet successfully passed the longitudinal vibration test in a 90-minute period. The operational speed for this orientation was 239 rpm. Rotating the pallet 90 degrees in a lateral orientation and subjecting it to a second 90-minute vibration caused no physical damage to the pallet or the adapter. The operational speed at this orientation was 233 rpm.

C. EDGEWISE DROP TEST. Each side of the pallet was placed on a beam in a turn displacing it 6 inches above the floor. The opposite side was raised to a height of 17 inches above the floor and then dropped. No damage occurred to the unit load on any of the four drops.

D. INCLINE-IMPACT TEST. The incline- impact test consisted of placing the pallet on an inclined platform with 2 inches of the pallet base projecting over the platform. The platform was then raised approximately 8 feet up the incline ramp and released allowing it to accelerate and impact into a solid wall. The test was repeated once on each side of the pallet. After completing this test, the pallet was observed to have no visible physical damage.

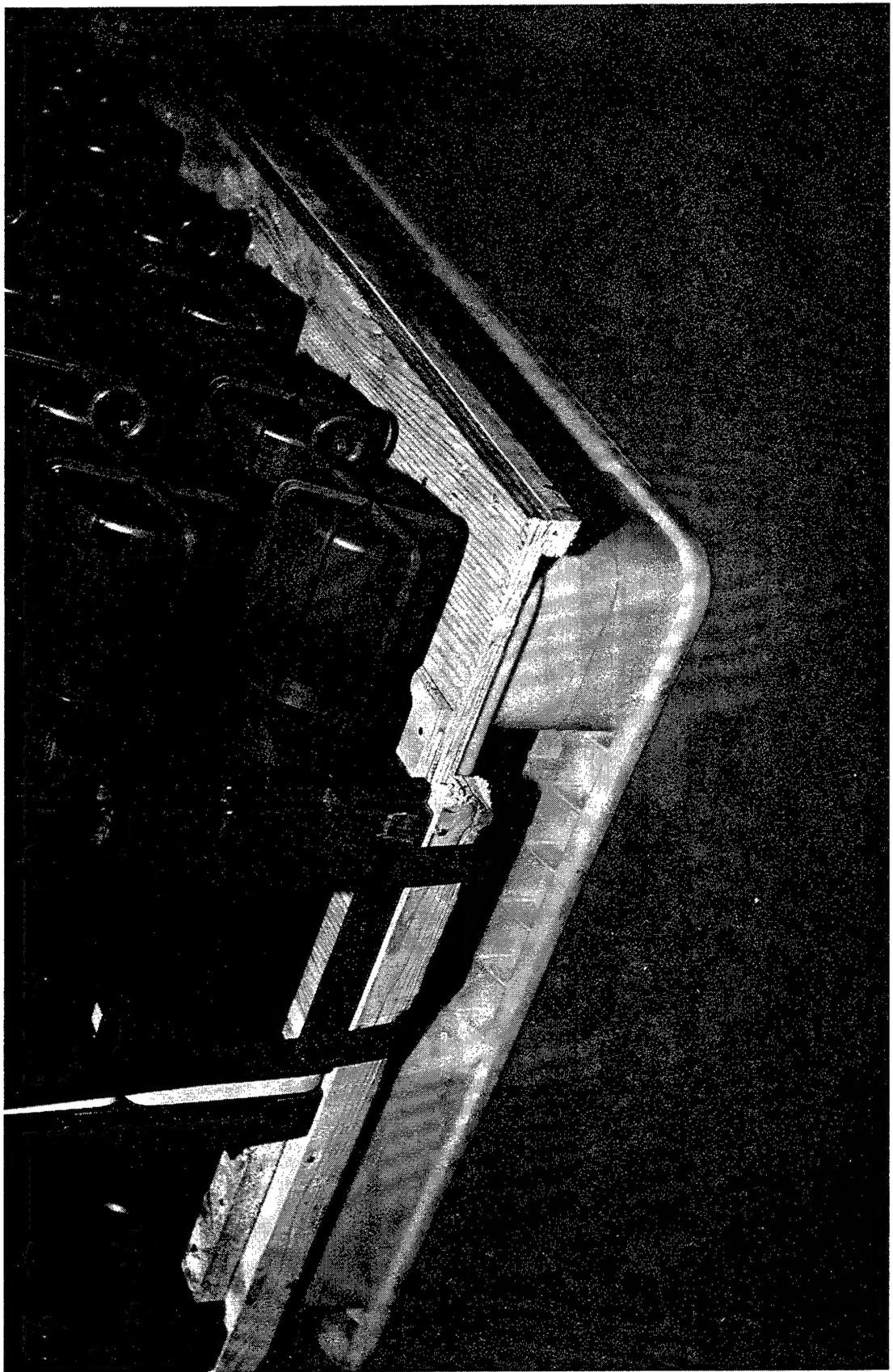
## PART 6

### PHOTOGRAPHS



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL -  
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AO317-SCN-96-4971. This photo shows the 81MM mortar plastic pallet unitized load prior to MIL-STD-1660 tests.



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AO317-SCN-96-4972. This photo shows the broken edge protector to the bottom adapter following the incline-impact test.